MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2023/2024 (TERM ID 2220)

EME 2066 – MEASUMENT AND INSTRUMENTATION

(ME)

5 JULY 2023
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages excluding the cover page with 4 Questions only.

2. Attempt all FOUR questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

4. Some useful equations are provided in the Appendix section at page 4 of this question paper.

Question 1

a) By means of a detailed and neat flow chart, illustrate the type of experimental errors.

[8 marks]

b) Based on your illustration in **Question 1(a)**, what type of error is most likely to occur when a humidity meter is used to measure the humidity of a given environment?

[2 marks]

c) **Figure Q1(c)** shows a poorly presented graph based on a certain dataset which illustrates the number of COVID-19 patients with respect to different geographical locations in Malaysia. Based on your understanding on statistical analysis, produce a more meaningful graph and explain your answer. In your graph, show the average number of COVID-19 patients for the five states.
(Note: Assume; A: Selangor with 8500 patients), B: Melaka with 8600 patients, C: Johor with 8800 patients, D: Perak with 8900 patients and E: Pahang with 10000 patients; Max and Min errors to be 100 for all states except Pahang where the max error = 250, min error = 500.)

[15 marks]

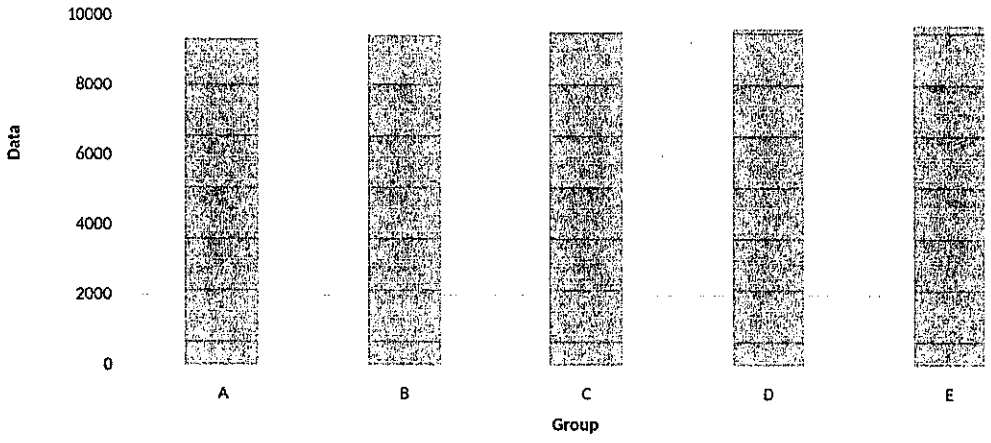

Figure Q1(c)

Continued...

Question 2

a) Illustrate by means of a neat sketch the three stages in a measurement system. **[9 marks]**

b) Two resistors R_1 and R_2 are connected in series and parallel. The values of the resistances are $R_1 = 100.0 \pm 0.1$ ohm and $R_2 = 50.0 \pm 0.03$ ohm. Calculate the uncertainty in the combined resistance at the following conditions:

i) Resistors are connected in serries connection. **[8 marks]**

ii) Resistors are connected in parallel connection. **[8 marks]**

Question 3

a) By means of an electrical resistance strain gauge, illustrate with a neat sketch the position of the strain gauge and its connection to the data logger to measure simultaneously the deflection of a bridge in x, y and z axis. **[6 marks]**

b) By means of a neat sketch and correct labeling, illustrate the main components in an accelerometer. **[9 marks]**

c) In the light of your knowledge on '*Machine Condition Monitoring*', illustrate with a neat sketch and appropriate diagrams on its application in the industries. **[10 marks]**

Continued...

Question 4

a) **Figure Q4(a)** shows the cross-section view of an aeroplane turbine. The turbine has been grounded for further maintenance works since it produces abnormal sound during operation. As an aviation engineer, illustrate how are you going to carry out your task and hence locate the root cause of the abnormal sound generated during operation. (Note: State all necessary procedures, relevant assumptions, vibration graphs, figures, diagrams and equipment's used to support your claims).

[17 marks]

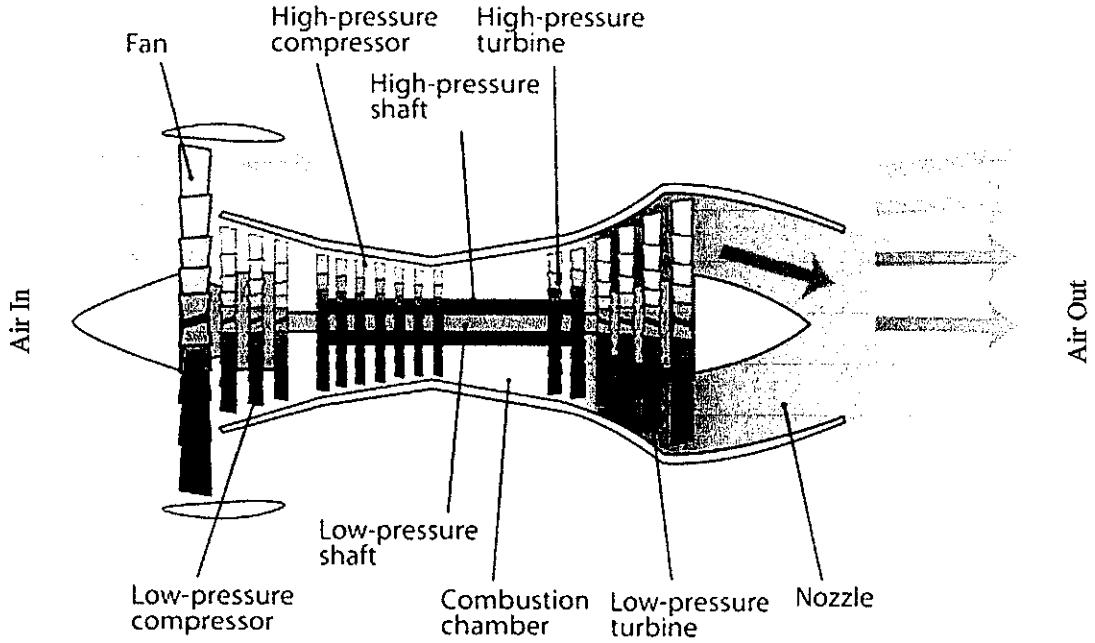

Figure Q4(a)

b) Illustrate the **FOUR** different types of strain gages. Give **ONE** application each for the different types of strain gages identified. **[8 marks]**

Continued...

APPENDIX

Useful Equations:

a) Resistance in Series Connection: $R_{Total} = R_1 + R_2 + \ldots R_n$; where n is the total number of resistors used.

b) Resistance in Parallel Connection: $R_{Total} = \frac{R1 \times R2 \times \ldots Rn}{R1 + R2 + \cdots Rn}$; where n is the total number of resistors used.

c) Uncertainty:

Let w_R be the uncertainty in the result and $w_1, w_2, \ldots, w_n$ be the uncertainties in the independent variables. If the uncertainties in the independent variables are all given with the same odds, then the uncertainty in the result having these odds is as follow:

$$w_R = \left[\left(\frac{\partial R}{\partial x_1} w_1 \right)^2 + \left(\frac{\partial R}{\partial x_2} w_2 \right)^2 + \cdots + \left(\frac{\partial R}{\partial x_n} w_n \right)^2 \right]^{1/2}$$

End of Paper